IMAGING OF EDGE IN SILICONE HYDROGEL CONTACT LENSES USING A SLIT LAMP-ADAPTED FOURIER-DOMAIN OPTICAL COHERENCE TOMOGRAPHY DEVICE

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Introduction

Poorly fitting contact lenses are more likely to alter ocular physiology than well fitting lenses and can contribute to the rejection of contact lenses[1]. Generally the fitting evaluation of soft contact lens is focused on lens centration, movement, and coverage and the slit lamp is the "gold standard" instrument for these [2]. These exams however may not be sufficient to determine the causes of various mechanical interactions that silicon hydrogel lenses may have on the conjunctiva. The formation of circumlimbal staining is in fact more frequently noted in silicon hydrogel contact lens wearers[3,4,5,6]. One possible cause of this anatomical alteration might be the interaction of the lens edge and the conjunctival epithelium. Contact lenses on the market in fact are differentiated not only by the type of material used and geometry but also by their edge profile[6]. Using the slit lamp once the contact lens is removed it is possible to note the presence of circumlimbal staining by the use of fluorescein or lissamine green dyes but on the other hand it is difficult to characterize the interaction between the lens edge and the conjunctival tissue[4]. This latter evaluation may be made using optical coherence tomography (OCT) imaging which is a non-invasive, non-contact, high resolution technology which provides cross-sectional images of objects that weakly absorb and scatter light used with success to visualize contact lenses on the eye [7,8].

Purpose

The purpose of the present work is to evaluate in vivo the effects of different edge profile of Silicone Hydrogel contact lenses on conjunctiva using a slit lamp-adapted Fourier-Domain OCT device.

Methods

We selected 20 subjects between 18 and 35 years of age with healthy anterior segments, no prior use of contact lenses, no contraindication for contact lenses wear and no staining of cornea and conjunctiva. The lenses power was between -1.00 and -6.50D. Four different silicone hydrogel lenses with different edge profile were fitted to every subject in separate sessions with a day to wash out the effects of the previous fitting between sessions. We used one lens with rounded edge apex (Purevision2 HD, B+L), one lens with one-sided edge profile and a pointed apex (Oasysis,Vistakon), one lens with two-sided edge profile - long side on the back surface (Air Optix, Ciba Vision) and one lens with two-sided edge profile - long side on the front surface (Biofinity, Cooper Vision). Every lens was checked after 30 minutes for movement and centration. After 6 hours of wear the fitting was checked anew and the edges of each lens verified in each quadrant using a slit lamp-adapted Fourier-Domain OCT (SL-SCAN 1, Topcon) (fig.1). After this exam the lenses were removed and the conjunctiva was evaluated with a slit lamp using a sodium fluorescein dye, and the clinical signs graded using the CCLRU grading scale[9]. To compare the variables within the groups we used the one-way ANOVA, where 'P<0.05' was considered as significant. Statistical analysis was performed with NCSS software.

Figure 1

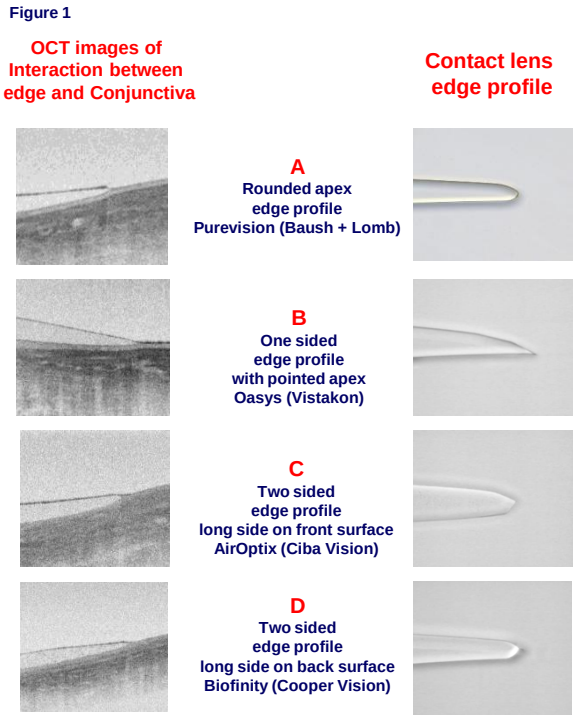
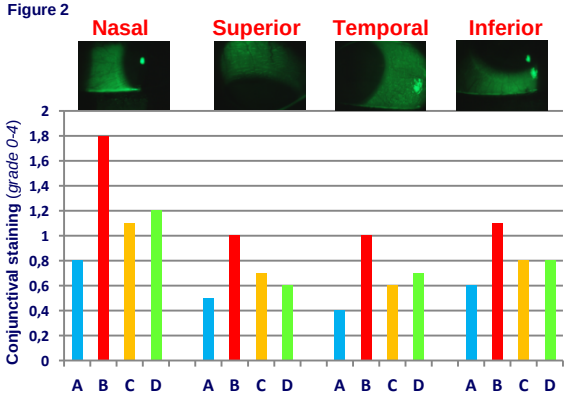


Figure 2



Results

In figure 2 are listed the results about the average of conjunctival staining measured in different positions and for all the lenses used. The maximum conjunctival staining was more evident in the nasal quadrant (N 1,8, S 0,8, T 0,9 and I 1,1) for the Oasys lens. The lens associated to the least conjunctival staining was the PureVision (N 0,8, S 0,5, T 0,4 and I 0,6). The differences in conjunctival staining was significant (p<0,05). Figure 1 reports OCT images of the edge of the different lenses used after 6 hours of wear in the nasal quadrant for a subject that presented conjuctival staining of grade 0 with lens PureVision, 3 with lens Oasys and 1 with lens AirOptix and Biofinity. It is evident the different behavior of Oasys lens edge which has the least gap between the edge tip and the conjunctival epithelium with respect to other profiles.

Conclusions

From our results it is evident that all the lenses after 6 hours of use may be associated to conjunctival staining although in most cases the amount was not significant. The staining of greater magnitude were associated with Oasys lenses and were more evident in the nasal quadrant. The different behavior could be explained by the different interaction between the edge of the lens and the conjunctiva compared to other edge profiles. Although the stiffness of silicone hydrogel materials could be considered cause of mechanical effects on the anterior segment[10] from our results the influence of the material seem less important than the edge profile of the lenses for the formation of conjunctival staining. In fact, the PureVision lens that is associated with lower incidence of conjunctival staining is made with a material (Balafilcon A) with a modulus of 1.1 MPa and a rounded edge while the Oasys lens which is made with a material (Senofilcon A) with a modulus of 0.7 MPa has "knife point" edge. The presence of more staining in the nasal quadrant could be explained by the different curvatures of the sclera; much flatter in the nasal quadrant than in the others[11]. In conclusion since the edge profile of contact lenses made in silicone hydrogel materials have an important role in the interactions with the conjunctiva their characterizations is especially important in cases where the presence of conjunctival staining is significant in order to determine the causes more precisely and thus to improve its management. The OCT technology can be very useful for this purpose, allowing us to make more accurate assessments of the interactions between the contact lens and the anterior segment. Since the results were obtained only after a day of use of different lenses, further studies will be needed to evaluate the long term effects of edge profile on the conjunctiva.

References

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